

**ECE-597: Probability, Random Processes, and Estimation**  
*Homework # 9*

Due: Friday May 22, 2015

From the textbook: 9.25, 9.28, 9.33 (part a only), 9.37 (assume  $a$  is real in part d), 9.46

*Hints and Answers:*

9.25, I would use psd's and then go back to autocorrelations for part b, but that is just me.

$$\mu_{\mathbf{Y}} = \frac{\mu_{\mathbf{X}}}{a}, R_{\mathbf{YY}}(\tau) = \frac{1}{2a}e^{-a|\tau|} + \left(\frac{\mu_{\mathbf{X}}}{a}\right)^2, \sigma_{\mathbf{Y}}^2 = \frac{1}{2a}.$$

$$9.28, S_{\mathbf{XW}}(\omega) = H(\omega).$$

$$9.33, S_{\mathbf{YY}}(\omega) = 2 \left[ \frac{\sin(2\omega)}{2\omega} \right]^2.$$

$$9.37, S_{\mathbf{YY}}(\omega) = |H(\omega)|^2 (S_{\mathbf{XX}}(\omega) + S_{\mathbf{NN}}(\omega)), S_{\mathbf{YX}}(\omega) = H(\omega)S_{\mathbf{XX}}(\omega), S_{\mathbf{XY}}(\omega) = H^*(\omega)S_{\mathbf{XX}}(\omega), \\ S_{\xi\xi}(\omega) = |1 - H(\omega)|^2 S_{\mathbf{XX}}(\omega) + |H(\omega)|^2 S_{\mathbf{NN}}(\omega), a = \frac{R_{\mathbf{XX}}(0)}{R_{\mathbf{XX}}(0) + R_{\mathbf{NN}}(0)}.$$

$$9.46, S_{\mathbf{YY}}(\omega) = |H(\omega)|^2 S_{\mathbf{XX}}(\omega) + S_{\mathbf{UU}}(\omega), S_{\mathbf{X}\hat{\mathbf{X}}}(\omega) = H^*(\omega)G^*(\omega)S_{\mathbf{XX}}(\omega), S_{\xi\xi}(\omega) = |1 - G(\omega)H(\omega)|^2 S_{\mathbf{XX}}(\omega) + |G(\omega)|^2 S_{\mathbf{UU}}(\omega).$$

**Additional Problem (which should be done first!)**

Show that the Fourier transform of  $R_{\mathbf{XX}}(\tau) = e^{-a|\tau|}$  is given by  $S_{\mathbf{XX}}(\omega) = \frac{2a}{a^2 + \omega^2}$